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Initial Observation of High Resolution Velocity Profile and Stratification in the Sunda Strait

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LONG-TERM GOALS

This pioneering work has main goal of observing and determining the dynamics of controlling circulation in the Sunda Strait – a strategic passage for marine safety and international shipping. (Figure 1).

OBJECTIVES

The main objectives are to:

(1) measure the magnitude and variability of Sunda Strait flow by deploying Barny Sentinel ADCP to determine the volume transport and its associated heat-freshwater fluxes;

(2) measure vertical stratification of the Sunda Strait and to study its effects due to rough topography/bathymetry, monsoon, and South Java Current.

(3) test the hypothesis whether coastally trapped Kelvin waves could penetrate the Sunda Strait. If it does, how it affects the Strait stratification, mixing, and its interaction with water from the Java Sea.

(4) determine effects of strait dynamics of fish distribution and abundance.

APPROACH

- ✓ Having international collaborative research among scientists from Lamont Doherty Earth Observatory (LDEO) United States, and Agency for Marine and Fisheries Research (BRKP) Indonesia, and First Institute of Oceanography (FIO), China.
- ✓ Deploy an array of bottom mount ADCPs in the chocked point of the Sunda Strait
- ✓ Take CTD casts and water samples at various locations within the straits and underway fishfinder as well as ADCP. CTD are taken in the locations of Krakatoa Volcano to investigate possibility of hydrothermal resources.
- ✓ Measure cross section bathymetric data along the mooring array as well as surrounding Krakatoa volcano.

Report Documentation Page

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WORK COMPLETED

- Two trawl-resistant bottom mounted (TRBM) moorings (one TRBM belongs to FIO and one TRBM belongs to LDEO) have been deployed in the north end of the Sunda Strait in early November 2008 using R/V Geomarin III.
- Twenty four CTD casts were taken during the November 2008 cruise.
- In October-November 2009, one mooring (FIO) was successfully recovered using ROV and divers.
- In January 2010, two replacement moorings (FIO) were successfully deployed in the northern edge of the Sunda Strait.
- We successfully recovered LDEO mooring October/November 2010.
- We will recover FIO moorings and redeploy LDEO mooring in September 21-26, 2011.

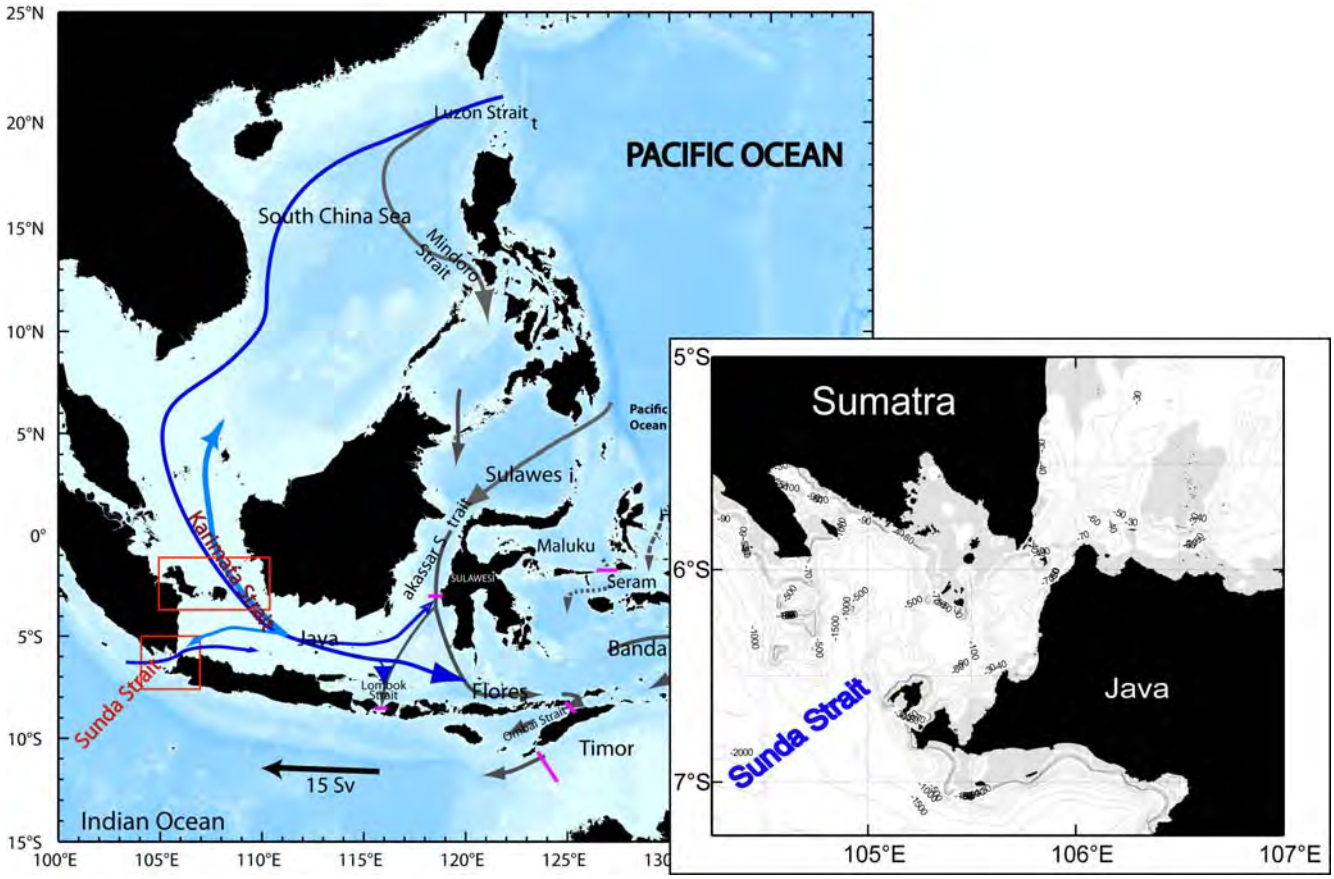

Figure 1. Indonesian throughflow pathways: Pacific-Makassar Strait-Indian Ocean and Pacific-Luzon Strait-South China Sea-Java Sea. Sunda Strait (red box and inset) connects the Java Sea and the Indian Ocean.

Figure 2. Mooring locations (red circle) and the tentative locations of CTD stations (yellow star) during the Sunda Strait cruise in September 21 to 26, 2011.

RESULTS

During the first cruise in November 2008, 24 CTD casts have been taken and preliminary results are presented in the Science, Technology and Policy Symposium as part of the World Ocean Conference, in Manado, Indonesia May 11-15, 2009 (Figure 2) and Ocean Obs09 Venice, Italy on 21-25 September 2009 as well as Ocean Science in Portland Oregon, February 2010; EGU meeting in Venice in April 2011. Preliminary results have been presented in EOS AGU manuscript (*Susanto et al*., 2010). A manuscript on Dynamics of Sunda Strait surrounding Krakatao Volcano is being prepared for submission to *Nature Geoscience (Susanto et al., 2011a, in prep).* A manuscript on time-frequency analysis of tidal signal within the Indonesian seas using Hilbert Huang Transform is being prepared (*Susanto et al.*, 2011b, in prep). Mini-workshop on South China Sea Throughflow and dynamics of Sunda Strait is planned for November 28-30, 2011.

IMPACT/IMPLICATIONS

Understanding dynamics of Sunda Strait has both scientific and economic benefits i.e. spatial and temporal variability of fish abundances, marine safety and environment and shipping. The Sunda Strait, which connects tropical Indian Ocean and Java Sea (Figure 1), is located between Java and Sumatra centered at 6.0°S and 105.0°E. An active growing volcano "*anak Kratatau*", which is located in the middle of the Strait, adds to the complexity of the rough topography. The Strait provides the first gab of series of Indonesian islands from Sumatra to Timor, where equatorial Kelvin waves from the tropical Indian Ocean propagate eastward along southern coast of this island series and seasonal upwelling along the southern Java-Sumatra (*Arief Murray, 1996; Sprintall et al., 2000; Susanto et al., 2001*). Whether these waves could enter the Sunda Strait is still unknown. Southern Java-Sumatra is also center of interannual variability associated with Indian Ocean Dipole (IOD). Hence, dynamics of Sunda Strait is hypothesized to be affected not only by the complex coastline topography and bathymetry, but also interactions between intraseasonal associated with Madden Julian Oscillation, monsoon, South Java Current, and Indian Ocean Dipole.

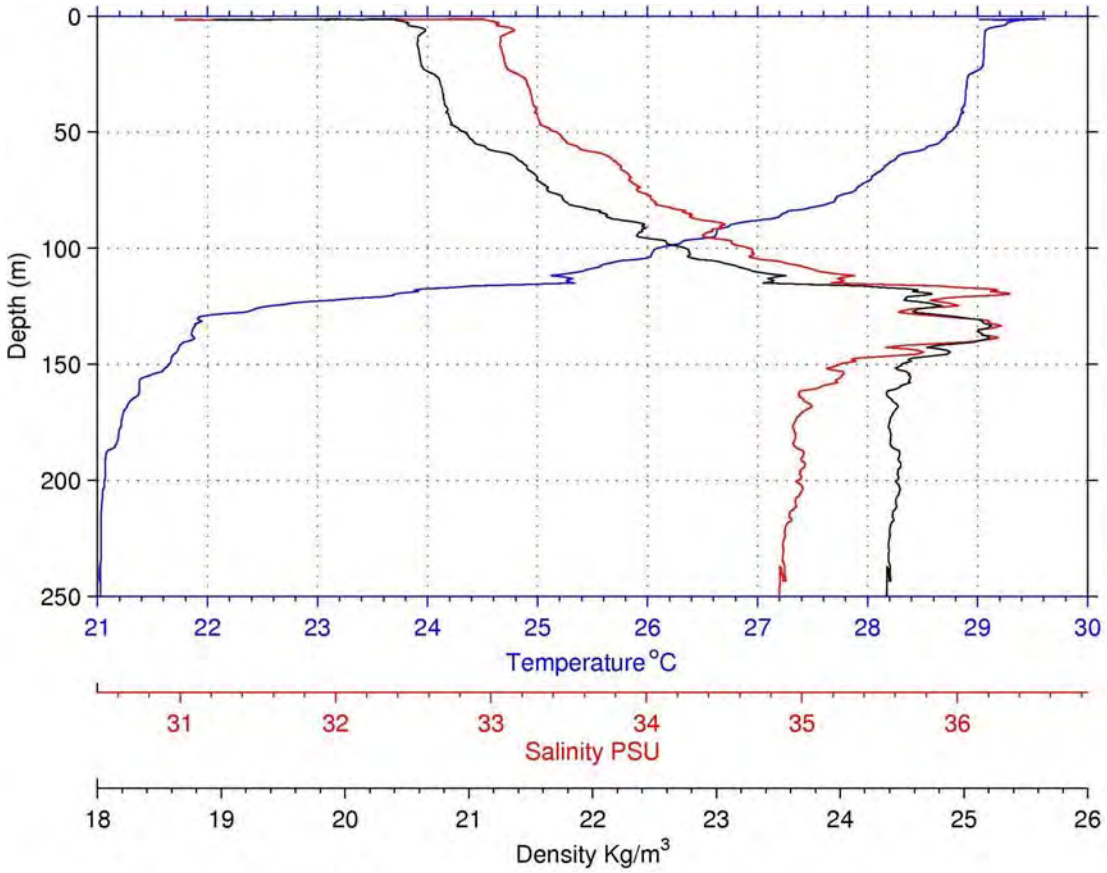

Figure 3. Water characteristic taken in the location which used to be the crater of Krakatoa Volcano (Susanto et al., 2011a).

RELATED PROJECT

- ✓ Ongoing project supported by NOAA to measure long-term ITF variability in the Makassar Strait as a continuation of the INSTANT program. Recovery redeployment is planned for May 2011.
- ✓ Ongoing collaborative project (China-Indonesia) to deploy moorings in the Indian Ocean south of the Sunda Strait. Chinese PIs led by Dr. Weidong Yu of the First Institute Oceanography is supported by Chinese NSF and Indonesian PIs led Dr. Budi Sulistyo (BRKP, Indonesia). Both of them have been my long-term collaborators.
- ✓ Ongoing collaborative project (Indonesia-China-USA) on South China Sea – Indonesian Seas Transport/Exchange (SITE) in the Karimata Strait has been funded by NSF starting Spring 2008. We will recover and redeploy three moorings in the Karimata on September 26 to October 4 2011 (after the completion of the Sunda Strait cruise).

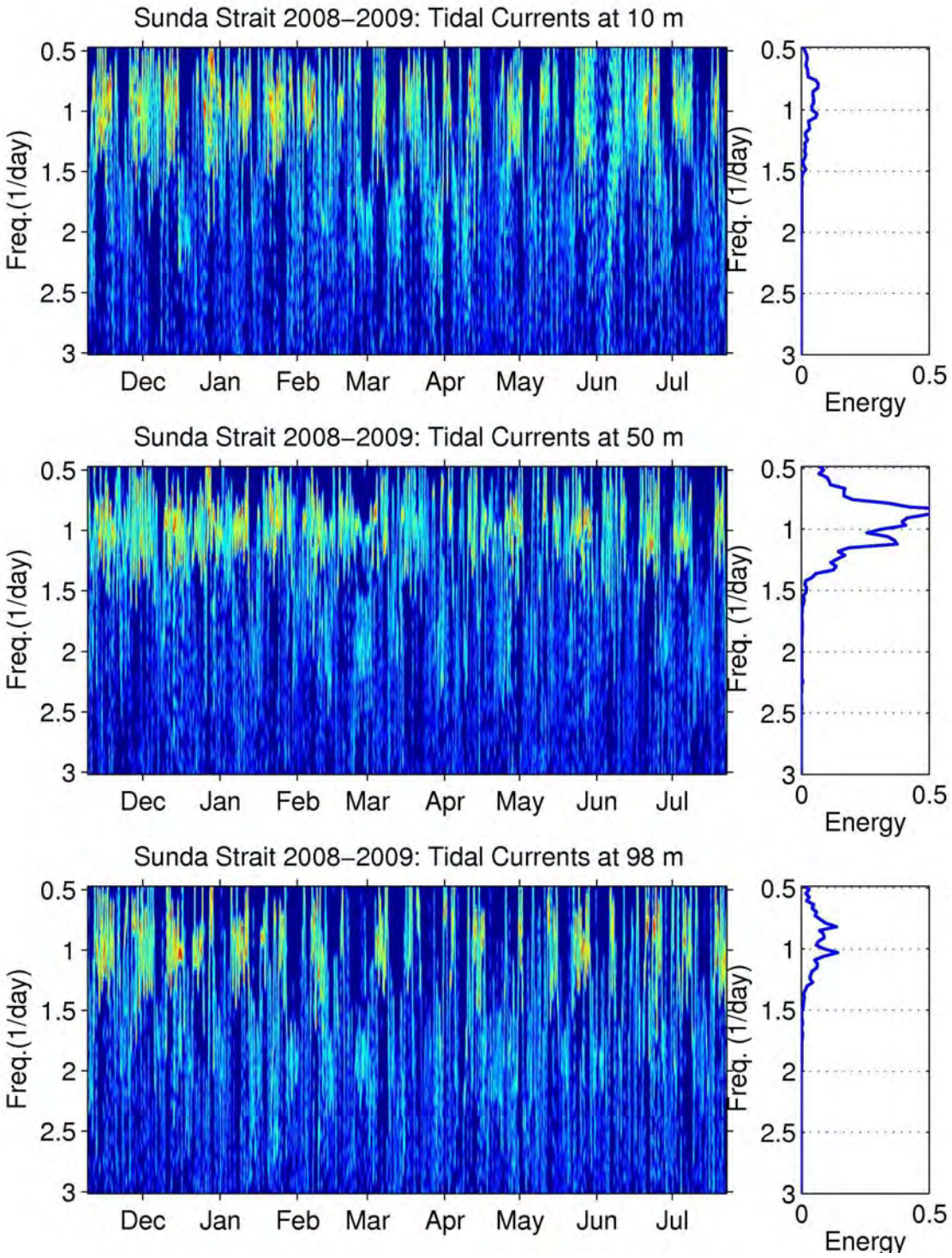

Figure 4. Spectrogram and spectrum of tidal signal in the Sunda Strait at various depths generated using Hilbert Huang Transform analysis (Huang et al., 1998). From the spectrogram and spectrum of velocity time series in the Sunda Strait, the dominant tide is diurnal. The spectrogram shows a straight line along wide band frequencies, representing superposition of some tidal components with a mean frequency of 1 cycle/day for the whole time series. Higher energy is observed at mid-depth compare to the surface and at the bottom. These spectrograms suggest that the tidal characteristics in the Sunda Strait are linear and periodic (Susanto et al., 2011b)

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